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LANDSAT 7 (L7) OPERATIONS AGREEMENT (OA) BETWEEN INTERNATIONAL GROUND STATIONS (IGS) AND L7

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Executive Summary

The International Ground Stations (IGSs) receive direct X-Band downlink data from the Enhanced Thematic Mapper Plus (ETM+) sensor on the Landsat 7 (L7) satellite. They interact with the satellite control center to schedule the downlinks and with the U.S. Geological Survey (USGS) archive to submit browse and metadata files. This document specifies and controls the operational interface between IGSs and L7 operations by clearly defining the activities between the IGS operators and the L7 operators.

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Contents

Executive Summary	iii
Document History	iv
Contents	v
List of Figures	vii
List of Tables	vii
Section 1 Introduction	1
1.1 Background	1
1.2 Purpose and Scope	1
1.3 Document Organization	1
Section 2 Facilities Description	2
2.1 Mission Operations Center (MOC)	2
2.2 Mission Management Office (MMO)	2
2.3 Landsat Archive Manager (LAM)	2
2.4 International Ground Stations (IGSs).....	2
2.5 Transportable IGSs	3
2.6 Backup MOC (bMOC)	3
Section 3 Operational Responsibilities - MOC	4
3.1 Products	4
3.2 Use of Administrative Messages	6
3.3 Retrieval of Files from the MOC	6
3.3.1 File Retrieval Instructions.....	7
3.3.2 IP Address and Directory Information	7
3.4 Sending of Files to the MOC	7
3.4.1 File Transfer Instructions	11
3.4.2 IP Address and Directory Information	12
3.5 Using the IGS Priority & Service Request Map Editor (IPM) Online Tool	12
3.5.1 Instructions For IPM Tool Use.....	12
3.5.2 Access Information	13
3.6 Handling of Sensitive Data	13
3.7 ftp Examples.....	13
3.7.1 Typical "put" ftp Session with the MOC.....	13
3.7.2 Typical "get" ftp Session with the MOC.....	13
3.8 MOC Transfer Problem Resolution.....	13
3.9 Backup MOC (bMOC) Operations	14
Section 4 Operational Responsibilities - MMO Interface	15
4.1 Introduction.....	15
4.2 Start-up of New Stations.....	15
4.3 IGS Memorandum of Understanding	16
4.4 IGS Operations Agreement	16
4.5 Billing and Accounting	16
4.6 Anomaly Resolution.....	16
4.7 Schedule Conflict Resolution, Including Night and Water Imaging	16
4.8 Landsat Ground Station Operators Working Group (LGSOWG)	16
Section 5 Operational Responsibilities - LAM Interface	18

5.1	Products	18
5.2	Sending Electronic Files to the LAM.....	18
5.2.1	PDR Formats for Electronic Delivery	19
5.2.2	File Transfer Instructions	20
5.2.3	Account and Directory Information.....	21
5.2.4	Typical "put" ftp Session with the LAM.....	21
5.2.5	LAM Transfer Problem Resolution	21
5.3	Sending Physical Media to the LAM.....	21
5.4	Receiving e-mail Files from the LAM	21
5.5	Appropriate IGS Actions for Reported Dispositions	22
5.6	Handling of Sensitive Data	23
5.7	Updating of Passwords for the LAM Server.....	23
Appendix A	Abbreviations and Acronyms	25
Appendix B	FOT Points of Contact	28
Appendix C	MMO Points of Contact.....	29
Appendix D	LAM Points of Contact.....	30
References	31

List of Figures

Figure 3-1. Sample FORMATS Product Report with Warning/Error Messages.....8

Figure 3-2. Sample Manual Priority/Request Mask Submission Failure Reports 10

Figure 3-3. Sample Manual Priority/Request Mask Submission Success Reports 11

List of Tables

Table 3-1. Product Descriptions – MOC / IGS..... 4-6

Table 3-2. FORMATS Product Report – Appropriate IGS Actions for Reported Warnings/Errors 9-10

Table 5-1. Product Descriptions – LAM / IGS..... 19

Table 5-2. Possible Disposition Messages and Their Meaning 22-23

Section 1 Introduction

1.1 Background

The International Ground Stations (IGSs) receive direct X-Band downlink data from the Landsat 7 (L7) satellite. They interact with the satellite control center to schedule the downlinks and with the Landsat Archive Manager (LAM) to submit browse and metadata files.

1.2 Purpose and Scope

This document specifies and controls the operational interface between IGSs and L7. Its purpose is to clearly define activities between the IGS operators and L7.

This agreement will become effective upon approval and will remain in effect throughout the operations phase of the L7 mission. Any subsequent changes to this document must be mutually agreed upon by the USGS Mission Management Office (MMO), on behalf of the IGSs, by the LAM, and by the L7 Flight Operations Team (FOT).

This Operational Agreement (OA) covers the operational interfaces between the Mission Operations Center (MOC) personnel and the IGS personnel and between the IGS personnel and the National Center for Earth Resources Observation and Science (EROS) LAM personnel.

1.3 Document Organization

This document consists of 5 sections, 4 appendices, and a References list:

- Section 1 identifies the document purpose, scope, and organization.
- Section 2 describes the facilities involved in the operational interfaces.
- Section 3 addresses the Operational Responsibilities related to the MOC-IGS interface.
- Section 4 addresses the Operational Responsibilities related to the MMO-IGS interface.
- Section 5 addresses the Operational Responsibilities related to the LAM-IGS interface.
- Appendix A defines the abbreviations and acronyms used in this document.
- Appendix B lists the relevant points of contact within the FOT and the conditions under which each should be used.
- Appendix C lists the relevant points of contact within the MMO and the conditions under which each should be used.
- Appendix D lists the relevant points of contact within the LAM and the conditions under which each should be used.
- References lists documents used to develop this OA or useful for further information.

Section 2 Facilities Description

2.1 Mission Operations Center (MOC)

The L7 MOC, located in Building 32 at Goddard Space Flight Center (GSFC), Greenbelt, Maryland, is operated by the USGS and provides the hardware and software systems necessary for the successful execution of real-time spacecraft operations and off-line scheduling and analysis activities. All command and control functions of the spacecraft take place in the MOC. From the MOC, the FOT ensures that spacecraft conditions are monitored and controlled. Along with ensuring the health and safety of the spacecraft, the FOT schedules and executes science data capture and retrieval. The FOT, using MOC tools, facilitates resource scheduling and interfaces with the appropriate elements required to conduct mission operations and meet the mission objective.

2.2 Mission Management Office (MMO)

To carry out its responsibility for L7 on-orbit operations, the USGS has established the Mission Management Office (MMO) to plan and direct those activities. The MMO acts on behalf of the Landsat Coordinating Group (LCG), which consists of senior agency officials at NASA and USGS who oversee the Landsat Program.

The L7 MMO is charged with implementation of the L7 Data Policy. In this capacity, the MMO is responsible for the day-to-day operations of the L7 System to fulfill that policy. The MMO establishes and maintains agreements with the IGSs for providing direct downlink L7 ETM+ data, provides for appropriate operational coordination, and acts as a point of contact for non-routine communications with the IGSs. Routine contacts with the IGSs are delegated by the MMO to the L7 FOT.

2.3 Landsat Archive Manager (LAM)

The Landsat Archive Manager (LAM) is located in Sioux Falls, South Dakota, at EROS. For L7, the LAM archives and distributes Level 0R data, metadata, and browse data. The LAM supports user queries and distributes data to users. It maintains an on-line library of IGS metadata and browse data for L7. The IGSs send metadata and (optionally) browse data to the LAM for inclusion in this library. The LAM also maintains a library of calibration parameters and mission information for L7.

2.4 International Ground Stations (IGSs)

In addition to downlinking X-Band image data to US facilities, the L7 spacecraft also downlinks image data to the IGSs. These stations receive real-time image data only as acquired within their acquisition circle. Each IGS signs a Memorandum of Understanding (MOU - Reference Document 2) with the USGS that specifies certain terms of agreement relating to the scheduling and operations affecting their access to image data downlinks. A list of possible IGSs is given in the Landsat Ground Station Identifiers document (Reference Document 4).

2.5 Transportable IGSs

In addition to downlinking X-Band image data to US facilities and the IGSs, the L7 spacecraft also downlinks image data to Transportable IGSs when required. Transportable IGSs are ground stations that change locations. Each Transportable IGS signs an MOU with the USGS which specifies certain terms of agreement relating to the scheduling and operations affecting their access to image data downlinks. Similar to IGSs, the Transportable IGSs receive real-time image data only, as acquired within their acquisition circle. From this point in this document, any reference to IGS includes the Transportable IGSs.

2.6 Backup MOC (bMOC)

A Backup MOC (bMOC) has been established at a location distant from Goddard Space Flight Center. In the event of an emergency requiring evacuation of the MOC, or a catastrophic equipment failure at the MOC, operations can be transferred to the bMOC. The backup MOC has full operational capability.

Section 3 Operational Responsibilities - MOC

3.1 Products

During on-orbit operations, the IGSs request image acquisition via Service Requests sent to the L7 open file server located in the MOC, either by ftp or by using the IGS Priority & Service Request Map Editor (IPM) online tool. As part of the new station start-up procedure, a unique user ID and password are assigned to each IGS to access the MOC open server and the IPM. The Service Requests from the IGSs are ingested by the MOC Scheduling system and incorporated into the Scheduler acquisition request database. These requests are honored as system resources allow. Conflicts are resolved in a manner agreed to by the MMO and the IGSs (see 4.7). The L7 spacecraft's ETM+ sensor is duty cycle limited by thermal and power constraints which could also preclude the honoring of IGS imaging requests.

Several products are exchanged between the IGSs and the FOT in the MOC. Table 3-1 lists the product descriptions, timespans, and delivery frequency

Product Name	From/ To	Product Description	Product Timespan	Delivery Frequency
STATION DESCRIPTION	IGSs to FOT	Provides FOT with information about ground station location and points of contact	Not Applicable (N/A)	Once before station startup, as baseline; updates as required, at least 7 days prior to effective date
SERVICE REQUEST (REQ file)	IGSs to FOT	Requests FOT to schedule transmission to ground station	Up to 10 imaging intervals	At least 36 hours prior to start of requested acquisition(s)
CONTACT SCHEDULE	FOT to IGSs	Notifies the station of scheduled X-Band on/off times	37 hours nominally	After every scheduling run that included a scheduled request for that ground station
ACQUIRED SCENES REPORT	FOT to IGSs	Notifies the station of the details of each scene scheduled for downlink in the corresponding contact schedule	37 hours nominally	After every scheduling run that considered a request from that station
DEFINITIVE EPHEMERIS REPORT	FOT to IGSs	Provides a definitive ephemeris point for every minute	61 hours nominally	Daily

Table 3-1. Product Descriptions - MOC / IGS (1 of 3)

Product Name	From/ To	Product Description	Product Timespan	Delivery Frequency
PRIORITY MASK (PRI file)	IGSs to FOT	Defines a priority (1/2/3) for each scene within the IGS's acquisition circle	Can be from 1 to 23 cycles	Once before station startup, as baseline; updates as required, at least 2 days prior to effective date
PRIORITY / SERVICE REQUEST MASK (PSR file)	IGSs to FOT	For scenes within IGS acquisition circle, either defines a priority or makes an acquisition request	Can be from 1 to 23 cycles	Priorities: once before station startup, as baseline, with updates as required at least 2 days prior to effective date Requests: as required, at least 2 days prior to effective date
<ul style="list-style-type: none"> • IIRV • BME, Two-line Elements 	FOT to IGSs	<ul style="list-style-type: none"> • LS7 position and velocity vectors • LS7 orbital elements Both types are for ground station use in pointing to LS7	<ul style="list-style-type: none"> • 96 hours or 120 hours nominally • Single vector 	<ul style="list-style-type: none"> • Mondays (96 hrs), Wednesdays (96 hrs), and Fridays (120 hrs) IIRVs are also delivered after an orbit adjust, which typically occurs on a Tuesday <ul style="list-style-type: none"> • Daily
PROBLEM REPORT	IGSs to FOT	Used to report potential satellite related problems during downlink receipt	N/A	Within 24 hours of detection of problem
ADMINISTRATIVE MESSAGE	IGSs to FOT, FOT to IGSs	Free form information not covered by other messages/files	N/A	As needed

Table 3-1. Product Descriptions - MOC / IGS (2 of 3)

Product Name	From/ To	Product Description	Product Timespan	Delivery Frequency
FORMATS Product Report	FOT to IGSs	Acknowledgment of receipt and ingest of IGS inbound files, and validation of service requests	N/A	Within 5 minutes of product receipt
MANUAL PRIORITY / REQUEST SUBMISSION REPORT	FOT to IGSs	Acknowledgment of receipt and ingest of PRI and PSR files; includes results of content validation	N/A	Within 5 minutes of product receipt
IPM LOG	FOT to IGSs	Record of activities during IPM online sessions	Appended to existing file; new file created as needed	Updated in real-time
CALIBRATION PARAMETER FILE	FOT to IGSs	Provides geometric and radiometric parameters for image processing	90 days nominally	Once before launch, updates nominally every 90 days

Table 3-1. Product Descriptions - MOC / IGS (3 of 3)

3.2 Use of Administrative Messages

The Administrative Message is utilized by both the MOC and IGSs to notify each other of anomalous conditions and to pass information not covered by other message types. The following list outlines the major reasons for which the MOC might send an Administrative Message:

- Delay in Contact Schedule file updates
- Notice of Calibration Parameters File update
- Notice of system and spacecraft status

The MOC notifies each IGS of a spacecraft contingency, spacecraft emergency, or planned maneuvers that affect imaging, using the Administrative Message. It is the responsibility of each IGS to poll the MOC server every day to ensure timely notification of possible non-imaging periods. For time critical messages, an e-mail version of the Administrative Message is sent to each IGS in addition to the message placed on the server. This may also be followed by a phone call to the station contact person. The e-mail address and phone number to be used is specified in the Station Description Message.

3.3 Retrieval of Files from the MOC

Files to be sent to the IGSs are placed on the MOC open server in the appropriate IGS output directory. It is the responsibility of each IGS to log onto the L7 file server daily and retrieve any files generated for the station, especially those related to scheduled acquisitions: the Contact Schedule, the Acquired Scenes Report, and the IRV/BME/NOR files.

It is recommended that each IGS poll its directory on the MOC open server each day before the first contact with the satellite to ensure these acquisition-related files have not been updated since the last poll.

The FOT nominally places the acquisition-related files on the MOC open server within the same two-hour window each day. The two-hour window opens at 2000Z and closes at 2200Z every day during normal operations.

3.3.1 File Retrieval Instructions

The following are the steps to be followed in retrieving files from the MOC open server:

1. Establish an ftp connection to the host using the Domain name and IP address
2. Once connected, enter your User name and Password
3. Change to the directory specified in section 3.3.2 for your site and the file type you wish to retrieve
4. Use the ftp "get" command to retrieve files from the MOC
5. When you have finished, use the ftp "bye" command to exit from ftp

3.3.2 IP Address and Directory Information

The specific IP address and directory information to retrieve products from the MOC are:

IP Address: (see section 3.6)
Domain Name: (see section 3.6)
User Name: **ID** (as listed in Table 2-2 of Reference Document 4)
Password: (see section 3.6)
Directory Structure: C:\LS7\ProductRepository\Outbound\Station**Country**\ID\Products
Used for the following files:
Contact Schedule
Acquired Scenes Report
Definitive Ephemeris Report
IRV, BME, NOR files
Calibration Parameter File
Administrative Message from FOT
(see Table 2-2 of Reference Document 4 for **Country** and **ID** values)

Directory Structure: C:\LS7\ProductRepository\Outbound\Station**Country**\ID\Reports
Used for the following files:
FORMATS Product Report
Manual Priority/Request Submission Report
IPM Log
(see Table 2-2 of Reference Document 4 for **Country** and **ID** values)

3.4 Sending of Files to the MOC

Files to be sent to the MOC are transferred to the MOC open server using file transfer protocol (ftp) and are placed in the appropriate IGS input directory. There are a few timing considerations:

1. The IGS Service Request message must be received by the MOC no later than 36 hours before the requested image acquisition start time(s).
2. The MOC requires 7 days to incorporate Station Description changes.

The MOC software generates a FORMATS Product Report or a Manual Priority/Request Mask Submission Report within 5 minutes of receipt of a file from an IGS. Each report acknowledges receipt and successful transfer of the IGS file into the MOC. The FORMATS report also reports on results of validating Service Request messages. If the Service Request message fails validation, appropriate warnings and/or errors are reported. Each warning/error contains a statement in brackets that begins with "message." A portion of a sample report is found in Figure 3-1. Table 3-2 includes some of these error statements and describes the appropriate actions to be taken by the IGS. The Manual Priority/Request Mask Submission Report also reports on results of validating the PSR file. If the mask fails validation, appropriate warnings and/or errors are reported. A sample report of a failed validation is shown in Figure 3-2 and a sample report of a successful validation is shown in Figure 3-3. The IPM tutorial Part D (Reference Document 3) describes the appropriate actions to be taken by the IGS for errors reported in the Manual Priority/Request Mask Submission Report.

```

FORMATS Product Report

L71998111PACREQ.S01xRPT
Date Generated: 1998:111:16:50:27

Product: 309_SVCREQ
Incoming File: L71998111PACREQ.S01

Message  Message
Type
INFO  L71998111PACREQ.S01 received by Transform.
WARN  [messages.wrongScIdLb1] (template line 96 input file line 14
      offset 398): We were hoping to see next the <S/C> part of the
      spacecraft ID label, but instead we read <TYP>.
WARN  [messages.wrongScIdLb2] (template line 102 input file line 14
      offset 400): We expected here to see <ID:> part of the spacecraft
      ID label, but instead we read the characters <E:>.
WARN  [messages.wrongScId] (template line 108 input file line 14 offset
      422): We expected here to see <7> as the spacecraft id value but
      instead we saw <R>.
WARN  [messages.startPathLabel1Check] (template line 113 input file
      line 14 offset 424): Text ( messages.startPathLabel1:EQ,EQI,
      'START') failed;
WARN  [messages.startPathLabel2Check] (template line 115 input file
      line 16 offset 431): Text ( messages.startPathLabel2:'S/C',EQI,
      'PATH:') failed;
ERROR [messages.startPathRangeCheck] (template line 117 input file line
      16 offset 435): Numeric ( messages.startPath:'ID:',GE,1) failed,
      AND, Numeric ( messages.startPath:'ID:',LE,233) failed;

Error count = 27
Warning count = 70
Total Messages = 99

```

Figure 3-1. Sample FORMATS Product Report with Warning/Error Messages

Reported Warning/Error Statement	Appropriate IGS Action
wrongScldLbl1 wrongScldLbl2	make sure the next line after DTG (for the first or only request) or after REQ. TYPE (for subsequent stacked requests) is correctly labeled "S/C ID:"
wrongScld	check that the value for S/C ID is "7"
startPathLabel1Check startPathLabel2Check	make sure the next line after S/C ID is correctly labeled "START PATH:"
startPathRangeCheck	check that the value for START PATH is between 1 and 233, inclusive
startRowLabel1Check startRowLabel2Check	make sure the next line after START PATH is correctly labeled "START ROW:"
startRowRangeCheck	check that the value for START ROW is between 1 and 248, inclusive
stopRowLabel1Check stopRowLabel2Check	make sure the next line after START ROW is correctly labeled "STOP ROW:"
stopRowRangeCheck	check that the value for STOP ROW is between 1 and 248, inclusive; if the range spans row 248 to row 1 (e.g. 246 thru 10), you must enter two requests: one for the range up through 248 and the other beginning at row 1 (e.g. 246 thru 248 and 1 thru 10)
startRowExceedsStopRow	check that the value for START ROW is less than the value for STOP ROW
effectiveDateLabel1Check effectiveDateLabel2Check	make sure the next line after STOP ROW is correctly labeled "EFFECTIVE DATE:"
effectDateFormatCheck	ensure the value for EFFECTIVE DATE is in the format yyyy-mm-dd; where yyyy is the year (1997 - 2100), mm is the month (01 - 12), and dd is the day (01 - 31)
expirationDateLabel1Check expirationDateLabel2Check	make sure the next line after EFFECTIVE DATE is correctly labeled "EXPIRATION DATE:"
expirDateFormatCheck	ensure the value for EXPIRATION DATE is in the format yyyy-mm-dd; where yyyy is the year (1997 - 2100), mm is the month (01 - 12), and dd is the day (01 - 31)
acqRateLabel1Check acqRateLabel2Check	make sure the next line after EXPIRATION DATE is correctly labeled "ACQ. RATE:"
acqRateRangeCheck	check that the value for ACQ. RATE is either "0" or "1"
minimumGapLabel1Check minimumGapLabel2Check	make sure the next line after ACQ. RATE is correctly labeled "MINIMUM GAP:"
minimumGapRangeCheck	check that the value for MINIMUM GAP is between 0 and 366, inclusive
maxSolarZenithLbl1Check maxSolarZenithLbl2Check maxSolarZenithLbl3Check maxSolarZenithLbl4Check	make sure the next line after MINIMUM GAP: is correctly labeled "MAX. SOLAR ZENITH ANGLE:"

Table 3-2. FORMATS Product Report - Appropriate IGS Actions for Reported Warnings/Errors (1 of 2)

getMaxSolarZenithAngle.maxSolarZenith RangeCheck	check that the value for MAX. SOLAR ZENITH ANGLE is between 0 and 90; note that the instrument limit is 75 for Northern Hemisphere daytime scenes, 85 for Southern Hemisphere daytime scenes.
reqTypeLabel1Check reqTypeLabel2Check	make sure the next line after MAX. SOLAR ZENITH ANGLE: is correctly labeled "REQ. TYPE:"
wrongReqTypeSize	ensure the entry for REQ. TYPE is 3 characters
rqstTypeWrong	make sure the entry for REQ. TYPE matches the 3 letter IGS name found in the file name

Table 3-2. FORMATS Product Report - Appropriate IGS Actions for Reported Warnings/Errors (2 of 2)

```
Manual Priority/Request Mask Submission Report

Station gnc
Priorities
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-07-19 10:04:55.952

The map priorities failed validation due to:
  path 4  row 42: Land priority assigned to water scene.
```

```
Manual Priority/Request Mask Submission Report

Station gnc
Requests
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-09-16 16:30:52.835

The map requests failed validation due to:
  path 18  row 46: Request for scene with no priority.
  path 18  row 47: Request for scene with no priority.
```

Figure 3-2. Sample Manual Priority/Request Mask Submission Failure Reports

Manual Priority/Request Mask Submission Report

Station gnc
Priorities
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-09-16 16:22:04.615

The map priorities passed validation.

Manual Priority/Request Mask Submission Report

Station gnc
Requests
Effective Cycle 1
Expiration Cycle 1
Start Path 18
Start Row 41

2002-09-16 16:22:06.408

The map requests passed validation.

Figure 3-3. Sample Manual Priority/Request Mask Submission Success Reports

3.4.1 File Transfer Instructions

The following are the steps to be followed in sending files to the MOC open server:

1. Establish an ftp connection to the host using Domain name and IP address
2. Once connected, enter your User name and Password
3. Change to the directory specified in section 3.4.2 for your site
4. Use the ftp "put" command to transfer files to the MOC
5. When you have finished, use the ftp "bye" command to exit from ftp

3.4.2 IP Address and Directory Information

The specific IP address and directory information to transmit products to the MOC are:

IP Address: (see section 3.6)
Domain Name: (see section 3.6)
User Name: **ID** (as listed in Table 2-2 of Reference Document 4)
Password: (see section 3.6)
Directory Structure: C:\LS7\ProductRepository\Inbound\Station**Country**\ID\Products

Used for the following files:

Station Description
Service Request (REQ)
Priority Mask (PRI)
Priority/Service Request Mask (PSR)
Problem Report
Administrative Message from IGS

(see Table 2-2 of Reference Document 4 for **Country** and **ID** values)

3.5 Using the IGS Priority & Service Request Map Editor (IPM) Online Tool

The IGSs have the option of submitting priority masks and service requests as a flat file using the interface outlined in section 3.4, or using the online IGS Priority & Service Request Map Editor (IPM) online tool to submit the same information over the Internet. Each station is assigned an account name and password allowing access to the IPM tool and updating of the masks for which the station is responsible.

3.5.1 Instructions For IPM Tool Use

1. Go to the URL and enter User Name and Password.
2. Select the station on which you want to work.
3. Select the cycle or season on which you want to work.
4. Select whether you want to work on Priorities, Requests, or both (the option to work on both at the same time is not recommended).
5. Edit the map as you wish.
6. Use the VALIDATE option to check the validity of your entries against the constraints.
For priorities, these include
 - a. the number of priority 1 scenes allowed each cycle day,
 - b. the combined number of priority 1 and 2 scenes allowed each cycle,
 - c. the number of paths each day on which priority 1 scenes are allowed,
 - d. whether the priority 1 scenes must be contiguous within a path, or not.For requests, these include whether there are already priorities assigned for the scenes requested.
7. When you have completed work on a map and are ready to finalize it, use the SUBMIT option to send the completed, validated map to the MOC for ingest.
8. A message is displayed showing the success or failure of the submit.

Online help pages are easily accessed as well as reference tools such as a list of dates within each cycle. Detailed instructions are given in the IPM Tutorial (Reference Document 3).

3.5.2 Access Information

The access information for the IPM online tool is:

URL: (see section 3.6)
User Name: **IC Name** (as listed in Table 2-3 of Reference Document 4)
Password: (see section 3.6)

3.6 Handling of Sensitive Data

Sensitive data related to the interface between the MOC and the IGSs are the user account password, domain name, IP address, and IPM URL. Each station, after signing on to become a Landsat-7 IGS, is sent a private attachment containing the sensitive data items required by the IGS to access the MOC open server and the IPM online tool. The sensitive data are sent via a postal service and will not be sent electronically. The address provided by the IGSs in the Station Description Message is used.

Passwords are required to be updated once each year; new passwords will be sent via postal service or via telephone.

3.7 ftp Examples

3.7.1 Typical "put" ftp Session with the MOC

```
>ftp <Enter Domain name here>  
Username: <Enter User name here>  
Password: <Enter Password here>  
>cd /LS7/ProductRepository/Inbound/Station/<country name>/<3-letter station ID>/Products  
>put <Filename>  
... once transfer is complete ...  
>bye
```

3.7.2 Typical "get" ftp Session with the MOC

```
>ftp <Enter Domain name here>  
Username: <Enter Username here>  
Password: <Enter Password here>  
>cd /LS7/ProductRepository/Outbound/Station/<country name>/<3-letter station ID>/Products  
>get <Filename>  
... once transfer is complete ...  
>bye
```

3.8 MOC Transfer Problem Resolution

There are several steps that can be taken if you are having problems:

1. Contact your local system administrator if you have any questions about your workstation/PC.
2. Initiate your ftp session with the MOC. If you can connect to the MOC, but cannot access the correct directory or cannot "put" or "get" files, contact the L7 FOT using the phone numbers in Appendix B. Please do not email sensitive data such as IP addresses and passwords.

3.9 Backup MOC (bMOC) Operations

A backup MOC (bMOC) has been established at a location distant from Goddard Space Flight Center. In the event of an emergency requiring evacuation of the MOC, or a catastrophic equipment failure at the MOC, operations can be transferred to the bMOC. The IGSs will be notified by e-mail and Administrative messages. The notification will include the new Domain name and IP address to be used to access the server at the bMOC. The directory structure, User Names, and Passwords will remain the same.

The database at the MOC is mirrored into the bMOC, so the IGSs should not have to resubmit any files. However, the stations should poll the Outgoing directory at the bMOC to make sure they have the latest products. There may be a slight delay in product deliveries (contact schedules, acquired scenes report, etc.) on the first day of the transition. Depending on the reason for the move to the bMOC, the spacecraft schedule may have changed and updated products may have been posted to the server. The FOT will provide any pertinent updates via Administrative Messages, e-mail, telephone, and/or fax. These updates will include any product delivery delays or issues, as well as the expected duration of operations from the bMOC.

Section 4 Operational Responsibilities - MMO Interface

4.1 Introduction

The MMO is responsible for the day-to-day operations of the overall L7 system, from spacecraft to ground system, to fulfill the L7 Data Policy. The MMO, acting on behalf of the Landsat Coordinating Group (LCG), interacts with the IGSs to establish and maintain operational agreement for direct downlink of L7 ETM+ data. The MMO provides operational coordination and resolves programmatic level issues to ensure the success of the L7 Mission. The areas of the L7 to IGS interface in which the MMO has operational responsibilities include:

- Start-up of new stations
- IGS Memorandum of Understanding
- IGS Operations Agreement
- Billing and accounting
- Anomaly resolution
- Schedule conflict resolution, including requests for night and water scenes

These are discussed in more detail in the following sections. The points of contact for the MMO are listed in Appendix C.

4.2 Start-up of New Stations

The MMO provides to each new IGS the information required to implement a L7 data receiving and processing station. This information includes:

- Radio frequency (RF) interface description, including antenna frequencies and downlink specifications
- data and message formats, including interfaces to the MOC and the LAM
- hardware and software requirements imposed by data format or satellite design
- test data for use in station checkout

When an IGS has signed an MOU with the USGS and is within 3 months of being operational, they are given the information required to access the servers at the MOC and the LAM, and the IPM online tool. This access will enable the exchange of test messages and test data files prior to the station coming on-line for routine operations. An important part of the start-up process is the submission of the Station Description message by the IGS to the MOC. This message enables the MOC and the LAM to prepare for both testing and routine operations with the station. Another part of the start-up process is the assignment of acquisition priorities to the scenes within the station circle, preferably via the IPM online tool.

4.3 IGS Memorandum of Understanding

Acting on behalf of the Landsat Coordinating Group (LCG), the MMO negotiates with the IGSs to establish and maintain operational agreements for direct downlink of L7 ETM+ data. The Memorandum of Understanding (MOU - Reference Document 2) is the formal vehicle for this bilateral agreement between USGS and the IGS, detailing responsibilities for each party and any costs involved. The MMO works with the IGS to resolve any issues related to the MOU between the USGS and the IGS.

4.4 IGS Operations Agreement

The MMO provides operational coordination and resolves programmatic level issues to ensure the success of the L7 mission. In this role, it acts on behalf of the IGSs in establishing an Operations Agreement (OA) with the three facilities that interface with the IGSs during operations: the MOC, the LAM, and the MMO. The MMO is also the point of contact for non-routine communication with the IGSs. The IGSs are encouraged to first use the routine interface channels identified in the Operations Agreement to resolve any problem. These channels include the Problem Report, the Administrative Message, and direct contact with the FOT or LAM.

4.5 Billing and Accounting

The MMO is responsible for setting up billing and accounting for access fees from the IGSs. Billing and accounting information is provided to the IGSs each quarter.

4.6 Anomaly Resolution

Any anomaly related to the direct downlink of L7 ETM+ data that cannot be resolved through the routine communications channels is directed to the MMO for resolution.

4.7 Schedule Conflict Resolution, Including Night and Water Imaging

It is possible for conflicts to arise during the scheduling process due to resource constraints. For the most part, these can be dealt with fairly by the Mission Planners using the Scheduling System software. If for some reason a conflict occurs that cannot be resolved by routine procedures, for example due to special IGS data acquisition requirements, the MMO will provide a mutually agreeable resolution in accordance with the MOU and the OA. Any requests for night or water imaging must be sent to the MMO for approval. The MMO will forward approved requests to the Mission Planners for scheduling.

4.8 Landsat Ground Station Operators Working Group (LGSOWG)

The MMO organizes and chairs the LGSOWG in accordance with Section 2.C of the MOU (Reference Document 2). The LGSOWG serves as a forum for exchange of programmatic, management, and technical information among ground station operators and the MMO. The IGSs designate their responsible representatives to participate in the LGSOWG which convenes annually at a location determined by the members.

At the LGSOWG, each IGS representative has an opportunity to provide a Station Status Report. The content of the report includes, but is not limited to, the following:

- Station Information: location, equipment, governing organizations, points of contact.
- Current and Planned Data Acquisition Activities: L7 and other data the station is collecting or plans to collect.
- Summary of L7 X-Band downlink statistics and quality.
- Statistical Summary of Acquired L7 Scenes: cloud cover percentages, user request rate and scene refresh rate.
- Summary of the Station's L7 Data Archive: archive equipment and procedures, total number of scenes archived; percentage of good quality scenes with acceptable cloud cover and percentage of coverage of the IGS nation's landmass per season.
- L7 Data Distribution Activities: how the system works, order interfaces, equipment, staff, customer information and support, data delivery summary by format and media.

The LGSOWG has authorized the establishment of a subgroup, the Landsat Technical Working Group (LTWG), to address technical issues related to the operation of Landsat ground stations. Each signatory Landsat ground station and USGS as the satellite operating agency provide technically-oriented representatives to the LTWG. The LTWG meets as a group once a year; subcommittees may meet or work on selected topics in-between these plenary sessions. Reports are made to the LGSOWG at the annual meeting. Issues that have been addressed in the past by the LTWG include:

- The Interface Control Document between the ground stations and the satellite operator
- The current satellite status and future plans
- Results of calibration studies and data quality analyses
- Archive strategies, including restoration of old media
- Data and product exchange philosophies and formats
- Problems or artifacts encountered during downlinks or during data processing

Section 5 Operational Responsibilities - LAM Interface

5.1 Products

The IGSs send metadata to the LAM for all L7 data they receive and archive. In accordance with the Memorandum of Understanding (MOU), metadata is sent to the LAM on at least a monthly basis. The IGSs must also send browse data to the LAM if they don't have an online browse archive at their facilities. Otherwise, browse delivery is optional.

There are five types of files associated with the transfer protocol between the IGS and the LAM:

- Product delivery record (PDR)
- Metadata product (MTA)
- Browse images (R##)
- Product delivery record discrepancy (PDRD)
- Product acceptance notification (PAN)

The protocol for the electronic transfer of metadata and browse data to the LAM comprises these five files:

- Product Delivery Record (PDR) – accompanies the product from the IGS to the LAM and describes the source, contents, and internal labeling of the metadata and browse products.
- Metadata product (MTA) – A product that contains Format 1 and Format 2 metadata for one L7 subinterval, and may include reference to accompanying browse images.
- Browse images (R##) – A browse image of each scene described in the metadata product.
- PDR Discrepancy (PDRD) – returned to the IGS from the LAM only if a problem is found while reading the PDR.
- Production Acceptance Notification (PAN) – returned to the IGS from the LAM to announce the status of each submitted PDR. If ingest fails, the PAN will contain a message that describes what errors were encountered.

The previously available option of sending metadata and browse data via physical media to the LAM has been deleted.

Table 5-1 summarizes the products and some of their characteristics.

5.2 Sending Electronic Files to the LAM

The metadata file(s), browse file(s), and associated Product Delivery Record file(s) are sent to the staging server from the IGS using file transfer protocol (ftp). They are placed in the appropriate IGS input directories. If an IGS chooses to send browse, they are placed in the same directory as the metadata file(s).

Product	From/ To	Product Description	Delivery Medium	Delivery Frequency
Metadata	IGS to LAM	Provides information about each ETM+ scene acquired	Electronic (ftp)	At least once a month
Browse data	IGS to LAM	Reduced volume representation of an image scene used to determine general ground area coverage and spatial relationships	Electronic (ftp)	At least once a month (optional product)
PDR	IGS to LAM	Describes source, contents, and internal labeling of the metadata and any browse	Electronic (ftp)	Delivered with the metadata and browse
PDR Discrepancy	LAM to IGS	Reports problems found during processing of the PDR	E-mail	As required
PAN	LAM to IGS	Reports processing status for every PDR file submitted to the LAM	E-mail	After ingest processing of each delivery

Table 5-1. Product Descriptions - LAM / IGS

5.2.1 PDR Formats for Electronic Delivery

If an IGS only sends metadata, the PDR is formatted as follows (Example ONLY, using Argentina's station ID (COA) and files):

```

ORIGINATING_SYSTEM = IGSCOA;
TOTAL_FILE_COUNT = 1;
OBJECT = FILE_GROUP;
    DATA_TYPE = L7IGS;
    NODE_NAME = <Host name>;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /IGS/META/COA/DATA;
        FILE_ID = L7COA216062200103110.MTA;
        FILE_TYPE = METADATA0;
        FILE_SIZE = 38027;
    END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;

```

If an IGS sends browse and metadata; the PDR is formatted as follows (Example ONLY, using Argentina's station ID (COA) and files):

```
ORIGINATING_SYSTEM = IGSCOA;
TOTAL_FILE_COUNT = 3;
OBJECT = FILE_GROUP;
    DATA_TYPE = L7IGS;
    NODE_NAME = <Host name>;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /IGS/META/COA/DATA;
        FILE_ID = L7COA001074200104260.MTA;      ** see note
        FILE_TYPE = METADATA0;
        FILE_SIZE = 15785;
    END_OBJECT = FILE_SPEC;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /IGS/META/COA/DATA;
        FILE_ID = L7COA00107420010426.R01;      ** see note
        FILE_TYPE = BROWSE;
        FILE_SIZE = 9953;
    END_OBJECT = FILE_SPEC;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /IGS/META/COA/DATA;
        FILE_ID = L7COA00107520010426.R02;      ** see note
        FILE_TYPE = BROWSE;
        FILE_SIZE = 17583;
    END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;
```

**** NOTE:** Fields in the metadata file should reference the same file names as the PDR using the following fields and formats (Example ONLY, using Argentina's station ID (**COA**) and files):

```
FILE_NAME = "L7COA00107420010426.MTA"
BROWSE_FILE_NAME = "L7COA00107420010426.R01"
BROWSE_FILE_NAME = "L7COA00107520010426.R02"
```

Please refer to the L7 to IGS ICD (Reference Document 1) for specific guidelines.

5.2.2 File Transfer Instructions

The following are the steps to be followed in sending files to the LAM staging server:

1. Establish an ftp connection to the host using the Host name. If you need to use the IP address, please use 'nslookup <Host name>' to determine the correct address.
2. Once connected, enter your User name and Password
3. Change to the metadata directory specified in section 5.2.3 for your site
4. Use the ftp "put" command to transfer metadata files (and browse) to the LAM
5. Change to the PDR directory specified in section 5.2.3 for your site
6. Use the ftp "put" command to transfer the PDR file(s) to the LAM
7. When you have finished, use the ftp "bye" command to exit from ftp

NOTE: Metadata and browse files need to be delivered before the PDR files. This will ensure the successful initiation of LAM ingest routines.

5.2.3 Account and Directory Information

LAM account information will be provided by mail to each IGS through either the MMO or IC Coordinator once the MOU has been signed and the IGS is within 3 months of being operational. The ftp directory structure for each IGS is as follows:

/IGS/META/<ID>

Refer to Table 2-2 of Reference Document 4 for <ID> codes.

5.2.4 Typical "put" ftp Session with the LAM

>ftp <Enter Host name here>

Username: <id>igs

Password: <Enter Password here>

>cd /IGS/META/<ID>

>put <MTA or browse Filename>

... once transfer of metadata and browse files is complete ...

>put <PDR Filename>

... once transfer of PDR file(s) is complete ...

>bye

NOTE: Metadata and browse files need to be delivered before the PDR files. This will ensure the successful initiation of LAM ingest routines.

Refer to Table 2-2 of Reference Document 4 for <id> and <ID> codes.

5.2.5 LAM Transfer Problem Resolution

There are several steps that can be taken if you are having problems:

1. Contact your local system administrator if you have any questions about your workstation/PC utilities such as ftp or SSH, or if you have any questions about your security protocols.
2. Use 'nslookup <Host name>' to determine the IP address if needed.
3. If you can connect to the LAM using ftp or SSH, but cannot access the correct directory or cannot "put" your files, contact the LAM using the information provided in Appendix D, and let them know you do not seem to have the correct permissions.
4. If you cannot connect to the LAM at all, try using trace route or other options (verbose option), and provide as much detail as possible to the LAM and to your system administrators.

5.3 Sending Physical Media to the LAM

This capability has been removed from the L7 program.

5.4 Receiving e-mail Files from the LAM

Files are sent from the LAM to the IGSs via e-mail. The actual file name of the PDR Discrepancy or PAN file is placed in the subject line of the e-mail message. The body of the e-mail message contains the file as defined in the L7 to IGS ICD (Reference Document 1).

5.5 Appropriate IGS Actions for Reported Dispositions

The files sent by e-mail to the IGS from the LAM report the results of PDR, metadata and browse data file ingest and archival at the LAM. In Table 5-2, the possible disposition messages that could be included in the PDR Discrepancy and PAN files are listed in alphabetical order along with a brief description of each.

No action should be taken by the IGS until they are contacted by the LAM operator. In almost all cases, the problem will be resolved by the LAM operator and the IGS will receive a second PAN message with the disposition of SUCCESSFUL. If the problem cannot be resolved by the LAM, the operator will contact the IGS to coordinate a resolution.

Reported Disposition	Description
ALL FILE GROUPS/FILES NOT FOUND	Metadata file not available when trying to ftp it; or file had a size of 0
DATA ARCHIVE ERROR	Problem during ingest of the metadata or browse files
DATA CONVERSION FAILURE	Error during ingest of the metadata or browse file
DATABASE FAILURES	Error in accessing the Ingest database
DUPLICATE FILE NAME IN GRANULE	A metadata or browse file name is a duplicate of an existing file name
INTERNAL ERROR	Error during ingest of the input files at EROS
FILE I/O ERROR	Problem during ingest of the input files
FTP COMMAND FAILURE	There is a problem with the ftp command
FTP FAILURE	Other ftp errors
INCORRECT NUMBER OF FILES	There are no input files; or the number of input browse or metadata files is not within the minimum and maximum limits for that type of file
INCORRECT NUMBER OF METADATA FILES	There should be one metadata file for each PDR
INVALID DATA TYPE	The DATA_TYPE parameter is missing from the file group; or the value along with its appropriate Version ID is not in the Ingest database
INVALID DIRECTORY	The DIRECTORY_ID parameter in the PDR is missing or empty for a file
INVALID FILE COUNT	The TOTAL_FILE_COUNT parameter is either missing or <=0
INVALID FILE ID	The FILE_ID parameter is missing or empty for a file
INVALID FILE SIZE	The FILE_SIZE parameter is missing, empty, or 0 for a file
INVALID FILE TYPE	The FILE_TYPE parameter is missing or empty for a file; or the value is not in the Ingest database for the given data type
INVALID NODE NAME	The NODE_NAME parameter in the PDR is missing or empty for the file group
INVALID OR MISSING FILE TYPE	The input file type is not properly entered in the Ingest database
METADATA PREPROCESSING ERROR	Error during ingest of the metadata file
MISSING OR INVALID ORIGINATING_SYSTEM PARAMETER	The ORIGINATING_SYSTEM parameter is missing or empty

Table 5-2. Possible Disposition Messages and Their Meaning (1 of 2)

Reported Disposition	Description
NETWORK FAILURE	ftp service not available
POST-TRANSFER FILE SIZE CHECK FAILURE	Either the FILE_SIZE parameter in the PDR is incorrect or the entire metadata or browse file(s) did not get ftp'd
REQUEST CANCELLED	Request was cancelled by the operator at EROS
RESOURCE ALLOCATION FAILURE	Error during ingest of the metadata or browse file(s)
SUCCESSFUL	Ingest of all files was successful
UNABLE TO ESTABLISH FTP CONNECTION	Cannot open ftp data connection

Table 5-2. Possible Disposition Messages and Their Meaning (2 of 2)

5.6 Handling of Sensitive Data

Sensitive data related to the interface between the LAM and the IGSs are the IP addresses and IGS passwords. Each station, after signing on to become a L7 IGS, is sent a private letter containing the sensitive data items required by the IGS to access the staging server for metadata and browse data delivery. These sensitive data are sent via a postal service and will not be sent electronically. The address provided by the IGSs in the Station Description message is used to mail this information.

5.7 Updating of Passwords for the LAM Server

Each IGS is assigned a password for access to the LAM IGS server. The IGS should change their assigned password as soon as possible upon receipt of the password and IP address. Each IGS should change their password every 6 months to remain in accordance with US Federal security guidelines.

To update or change the password for access to the LAM IGS server, you need Secure Shell (SSH) version 2.

Free SSH software is available from <http://www.openssh.com/>.

Other Web sites on SSH include the following:

<http://www.ssh.com/>

<http://www.ssh.com/company/sales/store/index.html>

<http://pgpdist.mit.edu/FiSSH/index.html>

For Frequently Asked Questions, refer to:

<http://www.employees.org/~satch/ssh/faq/ssh-faq.html>

NOTE: EROS is not responsible for the above Web pages or their contents. If you encounter any problems with these sites or the SSH software, please contact the Web administrator for the site or the SSH software provider.

Once you have acquired SSH software, follow these general instructions:

1. Have SSH installed on the machine from which you are going to access the LAM IGS server.
2. Ensure that your local firewall will permit outgoing SSH connects to port 22 for SSH2. Make sure you are using passive mode.
3. Log onto the LAM IGS server using the following:

```
ssh -l <user_name> -p 22 <Host_name>
```

To make troubleshooting easier, use the verbose option (-v) for debugging. For example, type:

```
ssh -v -l <user_name> -p <22> <Host_name>
```

4. Use the Unix command "passwd" to set up the new password:

```
(server_name)% passwd
Enter login password:<oldpassword>
Enter new password:<newpassword>
Confirm new password:<newpassword>
Password changed successfully
```

5. Log out of your SSH session by typing exit.

```
(server_name)% exit
```

NOTE: Please work with your system administrators if you encounter any problems. We are providing this information to you as general guidance. Your system may be configured to operate differently.

NOTE: The SSH is only required to be used to change your password. You do not need to use it to transfer files to the LAM server. For file transfers, use ftp "put."

Appendix A Abbreviations and Acronyms

ACQ.	Acquisition
Bldg.	Building
BME	Brouwer Mean Element
bMOC	Backup MOC
cd	Change Directory
DCN	Document Control Number
DTG	Date-Time Group
e-mail, E-mail	Electronic Mail
EROS	National Center for Earth Resources Observation and Science
ETM+	Enhanced Thematic Mapper Plus
fax	Facsimile
FORMATS	Flight Dynamics Facility Orbital and Mission Aids Transformation System
FOT	Flight Operations Team
ftp, FTP	File Transfer Protocol
gov	Government
GSFC	Goddard Space Flight Center
hrs	Hours
HTSI	Honeywell Technology Solutions Inc.
I/O	Input/Output
IC	International Cooperator
ICD	Interface Control Document
ID, id	Identification
IGS	International Ground Stations
IIRV	Improved Interrange Vector
IP	Internet Protocol
IPM	IGS Priority & Service Request Map Editor
IRV	Improved Interrange Vector message

L7	Landsat 7
LAM	Landsat Archive Manager
LCCR	Landsat Configuration Change Request
LCG	Landsat Coordinating Group
LGSOWG	Landsat Ground Station Operators Working Group
LP	Land Processes
LS	Landsat
LS7	Landsat 7
LTWG	Landsat Technical Working Group
MAX.	Maximum
MD	Maryland
MMO	Mission Management Office
MOC	Mission Operations Center
MOU	Memorandum of Understanding
MTA	Metadata file
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NOR	Two-Line Element message
OA	Operations Agreement
PAN	Production Acceptance Notification
PC	Personal Computer
PD	Project Document
PDR	Product Delivery Record
PDRD	Product Delivery Record Discrepancy
PRI	Priority Mask file
PSR	Priority/Service Request Mask file
REQ	Service Request file
REQ.	Request

RF	Radio Frequency
Rm.	Room
S/C	Spacecraft
SAIC	Science Applications International Corporation
SD	South Dakota
SSH	Secure Shell
URL	Uniform Resource Locator
US	United States
USA	United States of America
USGS	United States Geological Survey
Z	Zulu time (same as Greenwich Mean Time)

Appendix B FOT Points of Contact

For mission scheduling problems, concerns, or questions, contact the following:

During prime shift (~1200Z through 2300Z):

Michele Crizer	Mission Planning Lead
Tim Wilcox	Mission Planner
Sang Lee	Mission Planner
Rosemary Kioko	Mission Planner

Phone	(301) 614-5541 or (301) 614-5203
Fax	(301) 614-5263
E-mail	L7MPT@LISTSERV.GSFC.NASA.GOV
Mail Code	428.1
Address	GSFC/NASA Bldg. 32, Rm. C211 Greenbelt, MD 20771 USA

**In all other cases, contact the Mission Management Office.
(See Appendix C.)**

Appendix C MMO Points of Contact

Name & Title: Kristi Kline, Mission Management Officer (billing issues)

Phone: 605-594-2585

Fax: 605-594-6567

E-mail: kkline@usgs.gov

Address: USGS / EROS
Mundt Federal Building
Sioux Falls, SD 57198 USA

Name & Title: Ron Smilek, Flight Systems Manager (requests for night, water, specials)

Phone: 301-614-5158

Fax: 301-614-5263

Cell: 443-618-2975

E-mail: smilek@usgs.gov

Address: Landsat 7 Project, Code 428.1
GSFC
Greenbelt, MD 20771 USA

Name & Title: Mike Headley, Chief Engineer

Phone: 605-594-2644

Fax: 605-594-6567

Cell: 605-321-5660

E-mail: headley@usgs.gov

Address: USGS / EROS
Mundt Federal Building
Sioux Falls, SD 57198 USA

Name & Title: Steve Covington, IC Coordinator (MOU issues)

Phone: 301-614-5211

Fax: 301-614-5263

Cell: 443-618-2976

E-mail: steven.covington@gsfc.nasa.gov

Address: Landsat 7 Project, Code 428.1
GSFC
Greenbelt, MD 20771 USA

Appendix D LAM Points of Contact

Regarding archiving IGS metadata and browse data at EROS:

Name & Title: David Strande, IGS Data Quality Analyst

Phone: 605-594-2562

Fax: 605-594-6567

E-mail: strande@usgs.gov

Address: USGS / EROS
Mundt Federal Building
Sioux Falls, SD 57198 USA

Alternate: Jody Rundell

Phone: 605-594-2658

E-mail: rundell@usgs.gov

Regarding queries about using the EOS Data Gateway:

Name & Title: User Services

Phone: 605-594-6151

Fax: 605-594-6589

E-mail: custserv@edcmail.cr.usgs.gov

Address: USGS / EROS
Mundt Federal Building
Sioux Falls, SD 57198 USA

**In all other cases, contact the Mission Management Office.
(See Appendix C.)**

References

The latest version of the documents listed below were used as references for the development of this OA or can be used for further information. Web page addresses are also included to facilitate easy access to the documents.

Reference Document 1

USGS/EROS. 430-11-06-009 and LS-ICD-29. L7 to IGS Interface Control Document (ICD).
Available at: <http://landsat.usgs.gov/igsdocs.php>

Reference Document 2

USGS/EROS. IGS Memoranda of Understanding
Available from the MMO (See Appendix C for MMO contact information).
Generic document posted at: <http://landsat.usgs.gov/resource.php>

Reference Document 3

USGS/EROS. IGS Priority & Service Request Mask Editor (IPM) Tutorial Files:

- Introduction

- Part A - Priorities

- Part B - Requests

- Part C - Messages

- Part D - Manual Submission

- Part E - Updating the Land Definition

- Part F - Merged-IC Instructions

Available at: <http://landsat.usgs.gov/igsdocs.php>

Reference Document 4

USGS/EROS. LS-PD-24. Landsat Ground Station Identifiers.
Available at: <http://landsat.usgs.gov/resource.php>